

b) a basic material;
wherein the absorbent composition exhibits [an] a Free Swell value that is at least about 15 grams per gram of absorbent composition and a Time to Reach 60 Percent of Free Swell Capacity value of at least about 5 minutes.

Remarks

Claims 1-2, 4-16 and 33 are presented for Examiner Reddick's consideration.

Pursuant to 37 C.F.R. § 1.111, reconsideration of the present application in view of the foregoing amendments and the following remarks is respectfully requested.

I. Election of Species

By way of the Office Action mailed 11 July 1997, election of a single disclosed species was required for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable. For the water-swellable, water-insoluble polymer, Applicants hereby elect polyacrylic acid for further prosecution of claims 1-2, 4-16 and 33 on the merits. For the basic material, Applicants hereby elect chitosan for further prosecution of claims 1-2, 4-16 and 33 on the merits.

II. Restriction Requirement

By way of the Office Action mailed 11 July 1997, restriction was required to one of the following inventions: Group I (claims 1-16 and 33), drawn to an absorbent composition which includes an acidic water-swellable, water-insoluble polymer and a basic material, and a disposable absorbent product; and Group II (claims 17-32 and 34), drawn to an absorbent composition which includes a basic water-swellable, water-insoluble polymer and an acidic material, and a disposable absorbent product.

Applicants hereby elect to prosecute the invention of Group I (claims 1-16 and 33).
Applicants reserve the right to file a divisional application with respect to the invention of Group II (claims 17-32 and 34).

III. Rejections under 35 U.S.C. §112

Claims 1-16 and 33 stand rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. These rejections are respectfully **traversed** to the extent that they may apply to the presently presented claims.

A) The term “water-insoluble polymer” was alleged to constitute indefinite subject matter. However, Applicants’ specification expressly describes that a “water-insoluble polymer” is a material that, when exposed to an excess of water, swells to its equilibrium volume but does not dissolve into the solution. As such, a water-swellable, water-insoluble material generally retains its original identity or physical structure, but in a highly expanded state, during the absorption of the water and, thus, must have sufficient physical integrity to resist flow and fusion with neighboring particles (see Applicants’ specification, page 5, lines 22-27). Furthermore, Applicants’ specification provides ample examples of materials that are considered to be water-swellable, water-insoluble polymers (see Applicants’ specification, page 8, lines 15-21 and page 9, line 33 to page 10, line 2). Conversely, Applicants’ specification also expressly describes that a water-soluble material is one that substantially dissolves in excess water to form a solution, thereby losing its initial, typically particulate, form and becoming essentially molecularly dispersed throughout the water solution (see Applicants’ specification, page 5, lines 28-31).

The term “basic material” was also alleged to constitute indefinite subject matter. However, Applicants’ specification expressly describes that a “basic” material is a material that may act as an electron donor (see Applicants’ specification, page 8, lines 34-35). Such a definition is well recognized by the technical community (see, for example, the enclosed defintion for a Lewis base, from The Condensed Chemical Dictionary, Tenth Edition (1981), G.G. Hawley, Editor, page 614). Furthermore, Applicants’ specification provides ample examples of materials that are considered to be basic materials (see Applicants’ specification, page 9, line 29 to page 10, line 2; page 12, lines 1-7).

Applicants’ claims may be broad, but broad claims, no matter how broad, are not indefinite as long as the boundaries of the claims are capable of being understood. As such, Applicants contend that Applicants’ claims, when read in light of the specification, reasonably apprise those skilled in the art both of the utilization and scope of Applicants’ invention.

B) Claims 1, 2, 10, 11, 13, 16, and 33 stand rejected as constituting indefinite subject matter due to the use of the phrase “to about”. Claims 1, 2, 10, 11, 13, 16, and 33 have been amended

to use the term "and" in lieu of the phrase "to about". No new matter is intended to be added by these amendments.

C) Claim 8 stands rejected as constituting indefinite subject matter due to the use of the term "polyquaternary ammoniums". Claim 8 has been amended to correct a typographical error and, thus, to refer to "polyquaternary ammoniums". Basis for this amendment may be found in Applicants' specification, page 9, line 35.

D) Claim 8 stands rejected as constituting indefinite subject matter due to the use of the terms "organic salts" and "salts". Claim 8 has been amended to delete reference to the term "organic salts".

In view of the foregoing remarks and the described amendments to the claims, Applicants assert that Applicants' claims 1-2, 4-16 and 33 are patentable under 35 U.S.C. §112, second paragraph.

IV. Rejections under 35 U.S.C. § 102 and 35 U.S.C. § 103

By way of the Office Action mailed 11 July 1997, Examiner Reddick rejected claims 1-16 and 33 under 35 U.S.C. § 102(b) as allegedly being anticipated at the time the invention was made or, in the alternative, under 35 U.S.C. § 103 as obvious over and thus unpatentable in view of U.S. Patent 5,011,864 to Nielsen et al. (hereinafter referred to as "Nielsen").

By way of the Office Action mailed 11 July 1997, Examiner Reddick rejected claims 1-6 under 35 U.S.C. § 102(b) as allegedly being anticipated at the time the invention was made or, in the alternative, under 35 U.S.C. § 103 as obvious over and thus unpatentable in view of U.S. Patent 5,264,471, to Chmelir (hereinafter referred to as "Chmelir").

By way of the Office Action mailed 11 July 1997, Examiner Reddick rejected claims 1-16 and 33 under 35 U.S.C. § 102(e) as allegedly being anticipated at the time the invention was made or, in the alternative, under 35 U.S.C. § 103 as obvious over and thus unpatentable in view of U.S. Patent 5,612,411, to Gross (hereinafter referred to as "Gross").

By way of the Office Action mailed 11 July 1997, Examiner Reddick rejected claims 1-16 and 33 under 35 U.S.C. § 102(e) as allegedly being anticipated at the time the invention was made or, in the alternative, under 35 U.S.C. § 103 as obvious over and thus unpatentable in view of U.S. Patent 5,610,208, to Dairoku et al. (hereinafter referred to as "Dairoku").

These rejections are respectfully traversed to the extent that they may apply to the presently presented claims.

Nielsen discloses the use of polymers that are already highly water absorbent prior to the inclusion of such polymers in the latex foam prepared in Nielsen (see Nielsen, column 3, lines 34-44). One skilled in the art would recognize that such water-absorbing polymers would need to be substantially neutralized in order to be highly water-absorbent polymers (see, for example, the enclosed excerpt from "Textile Science and Technology 7: Absorbency", edited by P.K. Chatterjee, Elsevier, 1985, page 206, which explains the relationship between the degree of neutralization of a polymer and the absorbency exhibited by such polymer). Furthermore, Nielsen discloses that useful water-absorbing polymers may be prepared according to US Patent 4,076,663. In turn, US 4,076,663 discloses that it is desirable that any such polymers be neutralized in order to be absorbent (see US 4,076,663, column 3, lines 28-32; column 5, lines 35-40). A polymer that is substantially neutralized will exhibit a relatively fast absorption rate (see Applicants' specification, the Examples: Sample 1 in Tables 1, 3, 8).

Chmelir also discloses the use of polymers that are already highly water absorbent prior to the mixture of such polymers with a second component (see Chmelir, column 2 lines 35-40). Furthermore, the examples of Chmelir expressly disclose that the prepared polymers are neutralized prior to the mixture with the second component (see Chmelir, column 7, lines 9-12; column 8, lines 2-3, and 64-67).

Gross discloses a water-swellable, water-insoluble phycocolloid material, prepared by forming a first solution containing a water-soluble phycocolloid and then adding a second solution containing an ion capable of rendering the water-soluble phycocolloid water-insoluble (see Gross, the Abstract). Suitable phycocolloids include algin or carrageenan (see Gross, column 2, lines 35-45). In addition, other water-soluble materials such as polysaccharides or synthetic polymers (starches, carboxymethylcellulose, etc.) may be used along with the phycocolloid (see Gross, column 2, lines 60-67). The ion capable of rendering the phycocolloid water-insoluble is generally a positively charged, divalent ion which reacts with the phycocolloid (see Gross, column 4, lines 42-50). Calcium (from calcium chloride) and aluminum (from aluminum sulphate) are suitable ions (see Gross, column 3, lines 30-40 and 45-50). In Example 1, Gross indicates that chitosan may be used as an ionic compound (see Gross, column 8, lines 13-18; Samples 17-19 and 30-31). In Gross, the the ionic materials actually react with the polymer to crosslink it, thereby resulting in a single copolymer or poly lectroylte solution which is already neutralized.

Dairoku discloses a water-absorbing agent (polymer) prepared by mixing a water-absorbent resin containing a carboxyl group with a cross-linking agent, capable of reacting with the carboxyl group (of the water-absorbent resin), wherein a soluble additive is added to the reaction mixture (see Dairoku, column 3, lines 60-67). The water-absorbent resin can be a variety of known materials (see Dairoku, column 6, line 23 to column 9, line 6). Particularly, the resin is described as being neutralized (see Dairoku, column 6, lines 30-32; 34-35; and 45-49). The soluble additive is an inorganic acid, an organic acid, or a polyamino acid (see Dairoku, column 9, line 6 to column 11, line 7). Compounds having a pKa exceeding 7.0, recognized as basic compounds, are not included in the useful soluble additive (see Dairoku, column 9, lines 13-16 and 55-61). The soluble (acidic) additive is effective in optimizing the distribution of the cross-linking agent, enabling the prepared absorbing agent to exhibit improved absorptive properties and decreasing the amount of residue of the cross-linking agent (see Dairoku, column 13, lines 8-15). The soluble (acidic) additive is used in an amount of from 0.005 to 8 parts by weight, based on 100 parts by weight of the water-absorbing resin (see Dairoku, column 10, lines 57-60).

Applicants do not believe that Applicants' claims are anticipated by the cited references for the following reasons. All of the cited references disclose the use of polymers that are either already highly water absorbent or neutralized prior to the use of such polymers. One skilled in the art would recognize that any water-absorbing polymers would need to be substantially neutralized in order to be highly water-absorbent polymers.

In contrast, as amended, Applicants' claims recite that the acidic water-swellable, water-insoluble polymer: 1) exhibits having a pK_a between about 2 and 12 and 2) comprises acidic functional groups and has at least about 50 molar percent of the acidic functional groups in free acid form. Such properties of the acidic water-swellable, water-insoluble polymer have been found by Applicants' to be necessary in order to achieve the desired absorption properties of both high absorption capacity as well as a relatively slow absorption rate (see Applicants' specification, page 10, line 26 to page 11, line 24; and the Examples). Such limitations are neither disclosed nor suggested by the cited references.

As such, the cited references do not identically describe each and every element of Applicants' claimed invention and the cited references do not inevitably produce Applicants' claimed invention. Thus, Applicants' claims are not anticipated under 35 U.S.C. §102 in view of the cited references.

Applicants also do not believe that Applicants' claims are obvious in view of the cited references for the following reasons.

First, all of Applicants' claim limitations must be considered, especially when missing from the cited references. As indicated above, Applicants' claims recite that the acidic water-swellable, water-insoluble polymer: 1) exhibits having a pK_a between about 2 and 12 and, 2) comprises acidic functional groups and has at least about 50 molar percent of the acidic functional groups in free acid form. Such properties of the acidic water-swellable, water-insoluble polymer have been found by Applicants to be necessary in order to achieve the desired absorption properties of both high absorption capacity as well as a relatively slow absorption rate. There is no disclosure or suggestion of such limitations in the cited references. While the cited references disclose the use of polymers that are already highly water absorbent and/or neutralized, it is clear from the present specification that the Free Swell value and the Time to Reach 60 Percent of Free Swell Capacity value recited in Applicants' claims will not result from the use of polymers that are already substantially neutralized and, thus, already highly water absorbent. As such, the limitations that a water-swellable, water-insoluble carboxyalkyl polymer: 1) exhibits having a pK_a between about 2 and 12 and, 2) comprises acidic functional groups and has at least about 50 molar percent of the acidic functional groups in free acid form and exhibits desired Free Swell and the Time to Reach 60 Percent of Free Swell Capacity values are missing from the cited references. Thus, when claimed limitations are absent from cited references, the claimed limitations cannot be *prima facie* obvious in view of such references.

Second, the discovery of the source of a problem may result in a patentable invention even if the solution would have been obvious once the source of the problem was discovered. In the present application, Applicants have discovered that substantially neutralized polymers, such as most commercially available superabsorbent materials, generally exhibit relatively fast liquid absorbing properties (see Applicants' specification, page 2, lines 21-35; and the Examples).

To solve this problem, Applicants have discovered that when an acidic water-swellable, water-insoluble polymer, substantially in its free acid form is mixed with a basic second material, the resulting absorbent composition will exhibit both a relatively high capacity for liquid absorption as well as a relatively slow liquid absorbing rate. This is due, it is believed, to be because as the mixture is placed in an aqueous solution, the acidic water-swellable, water-insoluble polymer, substantially in its free acid form, reacts with the basic second material and the chemical equilibrium is in favor of converting the acidic water-swellable, water-insoluble polymer from its free acid form to its respective salt form. As such, the mixture comprising the converted

water-swellable, water-insoluble polymer will now exhibit a relatively high capacity for liquid absorption. However, because the conversion of the water-swellable, water-insoluble polymer, from its free acid form to its respective salt form is a relatively slow process of ionization and ion diffusion into the polymer, the water-swellable, water-insoluble polymer will also exhibit a relatively slow liquid absorbing rate. (See Applicants' specification, page 10, line 26 to page 11, line 24.) Furthermore, Applicants have demonstrated this improvement in absorbent properties for a variety of acidic water-swellable, water-insoluble polymers (see Applicants' specification, the Examples). As such, Applicants believe that they have demonstrated the criticality of the limitations recited in Applicants' claims in order to achieve the absorbent properties of the polymer recited in Applicants' claims. In contrast, the cited references do not disclose or suggest the problems that occur when a polymer is neutralized and/or exhibits too fast of a liquid absorbing rate. As such, when cited references do not disclose a problem or its source, the solution to the problem will not be *prima facie* obvious in view of such cited references.

Third, the cited references teach away from Applicants' claims. In particular, the cited references disclose the use of polymers that are already highly water absorbent and/or neutralized prior to the use of such polymers. In contrast, Applicants' claims a water-swellable, water-insoluble polymer that: 1) exhibits a pK_a between about 2 and 12 and, 2) comprises acidic functional groups and has at least about 50 molar percent of the acidic functional groups in free acid form which, as demonstrated in Applicants' Examples, will generally exhibit a relatively low liquid absorption capacity on their own. As such, when cited references teach away from a claimed invention, such teaching away is a *per se* demonstration of a lack of *prima facie* obviousness in view of the cited references.

For the above reasons, Applicants contend that Applicants' Claims 1-2, 4-16 and 33 are patentable under 35 U.S.C. §102 and under 35 U.S.C. §103 in view of the cited references.

For the reasons stated above, it is respectfully submitted that all of the presently presented claims are in form for allowance.

Please charge any prosecutorial fees which are due to Kimberly-Clark Worldwide, Inc. deposit account number 11-0875.

The undersigned may be reached at: 920-721-2661.

Respectfully submitted,

JIAN QIN ET AL.

By: John R. Schenian

John R. Schenian

Registration No.: 33,776

Attorney for Applicants

Enclosures:

The Condensed Chemical Dictionary, Tenth Edition (1981), G.G. Hawley, Editor, page 614

Textile Science and Technology 7: Absorbency", edited by P.K. Chatterjee, Elsevier, 1985, page 206

CERTIFICATE OF MAILING

I, Audrey J. Akmentins, hereby certify that on January 12, 1998, this document is being deposited with the United States Postal Service as first-class mail, postage prepaid, in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231.

By: Audrey J. Akmentins

Audrey J. Akmentins

The
Condensed Chemical
Dictionary

TENTH EDITION

Revised by

GESSNER G. HAWLEY

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compounds, such as boron trifluoride, BF_3 , and aluminum chloride, $AlCl_3$, exhibit the same behavior and are therefore properly called acids. Such substances show acid effects on indicator colors and when dissolved in the proper solvents.

Lewis base. A substance that forms a covalent bond by donating a pair of electrons, neutralization resulting from reaction between the base and the acid with formation of a coordinate covalent bond. It is also called a nucleophile. See also Lewis electron theory.

Lewis electron theory. A theory involving acid and base formation, neutralization, and related phenomena on the basis of exchange of electrons between substances and the formation of coordinate bonds. It represented an important advance in chemical theory, largely replacing earlier concepts. Advanced in 1923 by Gilbert N. Lewis, it contributed much to the development of coordination chemistry, in which the base is represented by the ligand and the acid by the metal ion.

Lewis, Gilbert N. (1875-1946). American chemist, native of Massachusetts; Professor of chemistry at M.I.T. from 1905 to 1912, after which he became dean of chemistry at University of California at Berkeley. His most creative contribution was the electron-pair theory of acids and bases which laid the groundwork for coordination chemistry. He was also a leading authority on thermodynamics.

lewisite. Legal label name for beta-chlorovinyl-dichloroarsine (q.v.).

"Lewisol" 28.²⁶⁶ Trademark for a pale, hard resin; a maleic-modified glycerol ester of rosin. Acid number 36, softening point 141° C; USDA color WG.

Lewis, Warren K. (1882-1974) Born in Laurel, Maryland; graduated from MIT in 1905; Ph.D. from University of Breslau, Germany in 1908. Became professor of chemical engineering at MIT in 1910. He is often regarded as the father of chemical engineering in the U.S., as his outstanding books and other publications did much to establish the fundamental principles of this field.

"Lexan."²⁴⁵ Trademark for thermoplastic carbonate-linked polymers produced by reacting bisphenol A and phosgene. Used in molding applications and other industrial arts.

See also polycarbonate resin.

"L-310 Fatty Acid."⁴⁸⁷ Trademark for a fatty acid derived from linseed oil. The major component acids are oleic, linoleic and linolenic. Light yellow liquid at ambient temperature; obtained from naturally occurring triglycerides; nontoxic, nonirritating.

Containers: Tank cars and trucks.

Uses: Chemical intermediate; paint and varnishes; alkyd resins and soaps.

Li Symbol for lithium.

"Librium" Hydrochloride.¹⁹⁰ Trademark for chlorzepoxide hydrochloride (q.v.). Manufacture and restricted.

licanic acid (4-keto-9,11,13-octadecatrienoic acid) $CH_3(CH_2)(CH:CH_2)(CH_2)COCH_2COOH$.

Properties: White crystals, alpha-Licanic acid (nearly occurring isomer) melts at 74-75° C. Re-isomerizes to the beta-form, m.p. 99.5° C. Soluble in organic solvents.

Derivation: Occurs in oiticica and other oil glycerides.

lichenic acid. See fumaric acid.

licorice. See glycyrrhizin.

lidocaine (alpha-diethylaminoaceto-2,6-xylidide) $C_6H_3(CH_2)_2NHCOC_2N(C_2H_5)_2$.

Properties: White or slightly yellow crystalline der; characteristic odor; m.p. 66-69° C; b.p. 182° C (at 4 mm); soluble in alcohol, eth chloroform; insoluble in water.

Derivation: By action of diethylamine or chloro xylidide.

Grade: U.S.P.

Use: Medicine (local anesthetic).

Liebig, Justus Von (1803-1873). German chemist who founded the *Annalen*, a world-famous chemical journal. He was a great teacher of chemistry, training such men as Hofmann, who did basic work on organic dyes. Liebig contributed original research in the fields of human physiology, plant life, chemistry, and was the discoverer of chloroform, chloral and cyanogen compounds. He was the first to recommend addition of nutrients to soils and may be considered the originator of the fertilizer industry.

life, origin (biogenesis). The succession of the events that led up to the appearance of organisms on earth about 3.3 billion years ago. According to one theory, substantiated by chemical evidence, this occurred as follows: inorganic compounds originally present were carbon dioxide, water, ammonia, and carbon dioxide. Carbides reacted with water to form methane, which in turn reacted with ammonia and water vapor as a result of an electric impulse to form amino acids, porphyrins, and nucleotides (or their precursors). All these compounds have been created artificially in the laboratory. It has further been shown that amino acids and nucleotides can be converted into proteins (and probably nucleic acids) by action of zinc-bearing clays, which were present on the shores of the primeval oceans. Little or no oxygen existed in the primordial atmosphere and the gases consisted chiefly of reducing gases. The chemical reactions which eventually resulted in the formation of DNA took place in an anaerobic environment, and the earliest living

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ABSORBENCY

EDITED BY

PRONOY K. CHATTERJEE

Materials Research, Personal Products Company, Milltown, New Jersey 08850, U.S.A.



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for additional absorption. The divalent cation crosslinker binds the long chain acrylic acid polymers to prevent the surface swelling which impedes absorption, thus creating a material capable of fast rates of absorption.

Superabsorbent polymers may form gel with solubilities ranging from soluble to insoluble depending upon the degree of cross-linking. A low degree of cross-linking generally results in a soluble material whereas a high degree of cross-linking reduces swelling and solubility. The water absorbency and solubility of a poly(sodium acrylate) superabsorbent is affected by the degree of cross-linking as is illustrated in Fig. 7.

Degree of neutralization of the ionic groups

The fluid absorbing ability of the polymer composition is influenced not only by the cross-linking density or the quantity of hydrophilic sites, but also by the degree of neutralization of the ionic groups. The absorption ability becomes highest when the ionic groups are completely neutralized with a suitable base, such as an alkali metal hydroxide. As the degree of neutralization is reduced, so is the absorption ability of the polymer [14,19].

This neutralization acts to unravel and straighten out the polymer chains in aqueous fluids so that the final absorbent composition is more swellable in the presence of such fluids. In cross-linked poly(methacrylic acid), swelling is a function of hydrogen ion concentration [20-22]. At pH 7 the copolymer of poly(2-hydroxyethyl methacrylate-methacrylic acid) exhibits nearly the same equilibrium water content as that of pure poly(2-hydroxyethyl methacrylate). However, after equilibrium with sodium hydroxide for 12 h, it is found that the sodium salt has dramatically increased the equilibrium water content [23].

Superabsorbent polymer gels have the greatest ability to absorb fluids when the pH of the fluids is between 8-10. This absorbent ability is markedly reduced in the pH range of less than 5 [6]. Table 1 exemplifies the water absorbent capacity of a poly(sodium acrylate) superabsorbent at a variety of fluid pH's [14].

Synthesis of Specific Compounds

Synthetic superabsorbents have been developed by a variety of techniques, e.g., suspension polymerization, inverse suspension polymerization and radiation polymerization. The classes of compounds used in the development of synthetic super-

TABLE 1

Effect of pH on Water Absorbent Capacity of Poly(Sodium Acrylate)

pH	Free swell capacity (g water/g)
12	85
7	90
5	60
3	< 10